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Estimating calcium carbonate production by Northwest Atlantic octocorals

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Cold-water corals are among several groups of temperate, boreal and polar calcium carbonate-producing organisms that may contribute to the global carbon cycle by their skeletal growth. While cold-water corals are generally thought to contribute less to total carbonate production than more widespread and faster-growing parts of the fauna such as bryozoans and mollusks, their production rates can be quite high where they occur. The coral fauna of the Northwest Atlantic continental margin is dominated by octocorals, with skeletal compositions ranging from pure protein to mixed magnesian calcite and protein. By contrast, the reef-building cold-water coral fauna of the NE Atlantic is dominated by colonial scleractinians with aragonitic skeletons.
Cold-water corals may exhibit high rates of gross carbonate production where they are locally abundant in coral forests and gardens. Their carbonate production may contribute to their provision of ecosystem services by habitat formation, and to altering boundary currents and increasing sedimentation rates. Among the most common calcifying octocorals in the NW Atlantic are the gorgonians Primnoa resedaeformis, Keratosisi grayi and Acanella arbuscula, and the pennatulaceans Pennatula grandis, Halipteris finmarchica, and Umbellula encrinus. The gorgonians are generally larger and more heavily calcified than the pennatulaceans, but the sea pens are usually more widely distributed, because they are not dependent on hard substrates.

Carbonate production in habitats built by these species was estimated based upon mass, skeletal carbonate content, age of colonies, and in-situ abundance estimates. Average and maximum individual calcification rates (g $CaCO_3$/ind /y) were estimated as average and maximum individual $CaCO_3$ mass divided by average and maximum age, based upon remotely operated vehicle (ROV), fishing bycatch, or box-core collections. Age was determined by counting growth bands, previously validated in each species using bomb-radiocarbon. Individual calcification rates were multiplied by average and maximum abundance estimates derived from ROV video surveys (n ind/m2) to yield average and maximum stand-level carbonate production rates (g $CaCO_3$/m2/y).
Carbonate production estimates ranged from 3.9-31.1 g /m2/y for Primnoa large gorgonian coral forests, from 23-41g/m2/y for Keratosis spp. bamboo coral forests, and 3.1 g/m2/y for Acanella small bamboo coral thickets. Sea pen meadow stand-level carbonate production estimates ranged from 0.01 g/m2/y for high Arctic Umbellula to 7.1 g/m2/y for maximum abundance in Pennatula spp. sea pen meadows. Variation in coral abundance had a greater influence on stand-level calcification rate than did individual calcification rate, similar to the importance of live coral cover in determining tropical coral reef net carbonate production estimates. These estimates are all 1-2 orders of magnitude smaller than published estimates of carbonate production by scleractinian-dominated cold-water coral reefs in the Northeast Atlantic, or by cold-water calcareous algae. These estimates are gross production, rather than net production accounting for dissolution and bioerosion, which are both likely affected by skeletal mineralogy and protein content. Ongoing work will compare carbonate production by cold-water coral systems between the NE and NW Atlantic.